SELLING PHYSICS ON TELEVISION AND IN THE CLASSROOM

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INTRODUCTION

The educational system in the United States is failing to train enough scientists and engineers to meet the needs of industry, the military and the universities. A series of major reports issued in the early 1980s such as *Educating Americans for the 21st Century* produced by a commission of the National Science Board (3) outlined the problem and suggested solutions. A particularly disturbing aspect of the problem is the failure of women and minority students to become scientists and engineers.

The shortage is particularly acute in the physical sciences. For instance, according to the American Institute of Physics Education and Employment Statistics Division, the years from 1972 to 1988 saw a 30% decrease in the number of U.S. citizens entering graduate school in physics. Foreign graduate students have partially filled the vacant places, but many of these students do not enter the U.S. workforce.

Recent articles reflect the concern of the American Association for the Advancement of Science (2), Sigma Xi (1) and the American Association of Physics Teachers (4). Each of these organizations has mounted a major campaign to induce more students to study science and to increase the scientific literacy of the American public. All of them express concern over the low enrollments of women and minority students in the sciences.

Even the popular press has become aware of the crisis in science education. Parade Magazine (5) and Time (6) recently carried articles urging national attention to recruiting more students into the study of science and increasing the scientific literacy of the American public.

The existence of a problem in science education in the United States is generally accepted and widely documented. Unfortunately the search for solutions to this problem is not simple. The problem has many facets including early perceptions of science gained from poorly trained elementary teachers and parents; stale science curricula in the middle and high schools which offer little opportunity for hands-on experimentation and take no advantage of new research on how students learn; and a public perception that science in general, physics in particular, is dull and boring.

SELLING PHYSICS

In order to increase enrollment in high school and college physics courses, we must interest students in studying physical science during middle school so that they will have the necessary background for the higher level courses. The students who regularly watch the many excellent science-oriented television shows such as public television's "Nova" need little encouragement to become interested in studying science. Unfortunately they are in the minority. Most students gain their perceptions of science and scientists from commercial television.

Popular television portrayals of physicists generally cast them as villains or unworldly fools whose love of science makes them easy dupes. Even physicist heros from the media present a less than realistic view of the life of a physicist. Consider for example the recent television shows "Misfits of Science" or "Head of the Class" and the movies "Buckaroo Bonzai," "Back to the Future," or "Real Genius." Not only commercial television but also the rest of the popular media have combined to paint physicists as distinctly different from the rest of society and probably a danger to it (7).

The Physics at the Indianapolis-500 Project seeks to use television commercials to "sell" the idea that physics is exciting, fun and accessible to the general public and simultaneously present a lesson on a basic principle of physics. Television is the primary learning tool for young people. Through programming like MTV, even pre-teens are used to fast, glitzy productions. In order to reach the audience of middle school students and, of course, their parents, we sought to build our advertising campaign around a television event that receives wide television coverage and is popular with our intended audience.

The Indianapolis-500 mile race is a statewide event in Indiana during the month of May. Because there is extensive media coverage throughout the month, even the public who are not racing fans learn to know drivers' names, top speeds, and events surrounding the race. There is a sense of pride and ownership for Hoosiers in the 500, and drivers are seen as heros by young people in the state.

The Physics at the Indianapolis-500 Project combines the interest in the race and the drivers with the most familiar medium for young people: the television commercial.

PROJECT DESIGN

The Physics at the Indianapolis-500 Project has designed five, sixty-second television spots, each of which uses an aspect of the 500-mile race to illustrate a principle of physics. The project has three major goals.

First, Physics at the Indianapolis-500 will create a more positive image of physics in the minds of teenagers, their parents and the general public by demonstrating that physics is part of the everyday world. Physics will be associated with the high glamor of racing. By showing that physics is useful in racing and easily understandable there, students will learn that they can understand physics and that it is of practical use in their lives.

Second, the project will present a general audience of television viewers with a few basic lessons in physics. A little bit of technical vocabulary is introduced so that the viewing audience will actually learn some physics principles. The television spots are designed to increase the scientific literacy of their audience as well as to illustrate the application of physics to automobile racing.

Finally, the project will make the spots available to schools along with a teacher's guide at a minimum cost. Many middle schools have poor laboratory facilities. Teachers are not given the time or they lack the knowledge and experience to design and conduct labs for their students. Although it is not a substitute for hands-on lab work, the use of media in teaching middle school physical science will be a considerable improvement over a straight lecture and book test system.

The spots will be high quality visuals each designed to illustrate a physics principle and its application to racing. They will use racing footage and computer graphics to illustrate the principles involved at a level easily comprehensible to the general public. The series will be narrated by a driver who is a hero to most of Indiana and introduced by a title sequence featuring physics. The spots are designed to be shown on commercial television during the broadcast of the race itself or during time trials.

The series will be filmed at the track in Indianapolis. Footage from previous races has been contributed by the Indianapolis Motor Speedway. Ball State University has recently acquired the equipment necessary for the production of high quality computer graphics and the professional editing of video tapes. Funding for the making of a pilot tape was provided by a grant from Ball State University.

The pilot tape is a spot on the Doppler effect in racing which shows how the characteristic change in pitch of a passing race car is produced. The spot introduces the idea that sound is a pressure wave in air. It also comments on the relationship between pitch and frequency, although the word frequency is not used. Computer generated graphics of a race car generating waves of differing frequency have been completed for this pilot tape, and an actor portrays the driver who would introduce the spots. Figure 1 is a still taken from a frame of the pilot video which shows the car created by the graphic artist.

The second planned spot concerns the Law of Conservation of Energy and the way in which racing cars are designed to destroy themselves in collisions to carry off the energy of the car and protect the driver. This spot will take advantage of stock footage of some of the terrible looking crashes at the race from which the driver has emerged unharmed. Computer graphics will be used to model a crash and demonstrate the conservation of energy.

The third spot deals with the steeply banked track at the Indianapolis Motor Speedway and the reason why it helps cars turn at high speeds. Graphics will be used to illustrate the centripetal force involved.

The fourth spot will be introduced by the famous scene at the beginning of the race where cars wobble down the track as drivers scuff their tires to increase friction with the track. The force of friction and the design of racing tires to increase it provide the theme of this spot.

Finally, we will ask why racing cars stay on the track since they travel at the speed of an airplane about to take off. This spot introduces the Bernoulli effect and its use in the design of cars.

THE INITIAL PHASE OF THE PROJECT

All five spots have been developed in detail and a story board prepared for each of them. The segment on the Doppler Effect has actually been produced as a rough pilot to illustrate the use of the computer graphics in the project. The pilot tape has two purposes. First, it will help in persuading commercial sponsors to fund the project. Secondly, we wanted to be certain that middle school students could learn physics from such a short tape.

In order to ascertain the degree to which students learned from the tape, we obtained the assistance of several middle school science teachers, Mrs. Nancy Watson of Burris Laboratory School in Muncie and Mrs. Charlene Mieir, Mrs. Dee Williams, Mr. Lee Witt and Mrs. Cheryl Fuller of East Side Middle School in Anderson. Two eighth grade science classes at Burris, three eighth grade science classes at East Side and two sixth grade science classes at Burris were given a pretest on the Doppler effect. Several days later, each class was shown the pilot video and then given a post test. Results of this simple experiment shown in Figure 2 demonstrate that students did learn basic physics from the short video.

We also asked the 147 students who participated in the study to fill out a questionnaire describing their reactions to the video. They were generally very positive.

Although the implication is flattering, we feel that the spots must be tested when they are actually part of television programming.

Finally we examined our data to see if we could detect any difference in the response of male and female students. While we found small differences, none of them were statistically significant. In the future, we hope to expand the study to see whether continued exposure to the spots as commercials will increase learning and to look at the long term retention of the physics concepts presented.

CONCLUSIONS

The results of our limited study of the learning of middle school students has convinced us that the medium of the television commercial can be used not only to "sell" physics as an interesting pursuit, but also to teach simple principles to middle school students. We intend to actively seek funding to continue the project and produce the remaining spots.

An interesting side effect of the study has been the discovery of how essential a multi-disciplinary team is to the project and how very different the approach of the disciplines to the project can be. We are professors of physics and astronomy, telecommunications and journalism, a senior student majoring in secondary mathematic education and a producer. Each of us has had a major role in the project and has learned from the other members of the team. The physicist had to be persuaded to speak simple English instead of technical jargon by the journalist who is a sports writer by profession. The telecommunications specialist had to understand the physics and translate it into a form from which the producer could work. Finally the producer worked with the physicist to ensure the accuracy of the finished product. The student of secondary education supervised the testing done in the middle schools and provided a fresh response to the entire project.

We are convinced that this sort of cross disciplinary team effort will be required to reach students early enough so that we can produce the physicists our society needs. It requires work to establish lines of communication that best utilize each discipline's strengths, but a variety of skills are needed to tackle a problem as complex as the crisis we face in science education.

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